

## Paradoxical Sahel: rich wetlands surrounded with arid bush steppe\*

by Gérard J. Morel

The Sahel can be described as a belt several hundred km wide, lying south of the Sahara, its southern margin abutting against the sudanian broad-leaved, dry savannah. It thus occupies the latitudes between 15° and 17°N, and is therefore within the Tropics. From the naturalist's point of view, however, the Sahel is more aptly defined by the rainfall, on which plants and animals so closely depend. The average Sahelian rainfall is 300 mm a year, with large variations: from 100 mm (or even less) to 600 mm. It is worth pointing out that a rainfall of 300 mm is about half that of the Normandy coast—and, I suppose, the British coast opposite as well, both of which are reputedly quite humid; but the Sahelian rains only occur mainly during 2 months, August and September, often in violent and inadequate downpours. Consequently, the Sahelian creatures, Man included, have to put up with insufficient rain and, above all, with 9 or 10 rainless months, conditions which are made even worse by evaporation which takes toll of 1 cm of water a day on average. The occurrence of the rains at a fixed date—even if these rains are very light in certain years—has strongly influenced the ecological solutions evolved by living organisms in order to survive. Birds, indeed, at least those species breeding during the rains, prepare themselves for breeding well in advance of the rains.

The trees, which are mostly thorny, hardly reach 10 m in the least dry places and are nowhere dense enough to constitute woodland—except in the rivers' valleys. The main genera are *Acacia* and *Balanites*, which put on new foliage during the short rainy season, while at the same time a grass layer, c. 50 cm high, grows rapidly and a short-lived and abundant insect life flourishes. The seeds produced by the grass layer fall on the ground and remain there, available until the next rains, of which the numerous seed-eating bird and mammal species take advantage. It is also worth observing that this temporary peak occurs as the Palaearctic migrants undertake their autumn migration over the Sahara.

The Sahel, nevertheless, in contrast to any other country, does not depend solely on the local rains. Its most salient features are the 2 large rivers, the Senegal and Niger, which are not fed by the scanty Sahelian rains, but by tributaries which catch their water far away in the Fouta Djallon mountain range of Guinea. These rivers have a seasonal regime and annually flood very large expanses of lowlands, quite independently of the local rains. The inundation zones are made up of an intricate system of temporary rivers, marshes and ponds which produce wild rice, water-lilies, reedbeds etc, the rapid and unrelenting evaporation creating mud-flats suitable for such as waders. The flood is also the time for most species of fish to spawn; but by the end of the flood, as the water grows shallower and many ponds are isolated, many small fish are unable to escape and are then an easy prey for fish-eating species. Thick woodlands of a particular

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*Acacia*, *A. nilotica*, grow on some floodable, clayish soils; being the only genuine woodlands in this latitude, they play an important rôle in the general ecology.

The Sahel is thus comprised of 2 strongly different eco-systems which operate in near independence.

What sorts of birds are to be found in such a contrasted and trying environment? Naturally, species closely adapted to aridity and species associated with wetlands, will be present; but the outstanding character of the Sahel bird fauna, taken as a whole, is the number of migrants, both Palaearctic and Afrotropical which are included, because migrants respond strongly to seasonal climates. In the list of northern Senegal birds are some 150 Palaearctic species I have identified out of a total of 370 species (the coastal species, but not the true marine species, being included); the Palaearctic migrants thus account for 40% of this list. However high this percentage may appear, it does not give a real idea of its actual impact, because the population of several Palaearctic species (e.g. ducks) largely outnumbers that of the equivalent native species.

### The Bush Steppe

This is the typical Sahel, relentlessly dry for 9 continuous months. Three main groups of birds which inhabit, at least temporarily, this steppe, can be distinguished.

*Sedentary species*, so called, although they are more or less nomadic: Helmeted Guinea-fowl *Numida meleagris*, Senegal Parrot *Poicephalus senegalus*, Long-tailed Parakeet *Psittacula krameri*, Chestnut-bellied Sand-grouse *Pterocles exustus*, Temminck's Courser *Cursorius temminckii*, Chestnut-backed Finch-lark *Eremopterix leucotis*, and several African warblers (*Eremomela*, *Sylvietta* . . .).

*Afrotropical migrants*, including both short and long-range migrants. Amongst them: Denham's Bustard *Otis denhami* (a very large bird), Bronze-winged Courser *Cursorius chalcopterus*, a sand-grouse, a bee-eater, and several cuckoos and kingfishers. Some migrants have their breeding quarters farther south, in a more wooded region and come north only for the off-season; but several species (White-throated Bee-eater *Merops albicollis*, several cuckoos) come to the Sahel in order to breed there.

*Palaearctic migrants*, which will be elaborated on later.

In actual fact, since many Afrotropical species are nomadic or migratory and since all the Palaearctic birds are migratory, the Sahel population is ceaselessly changing in the species' efforts to cope with seasonal and variable resources. We have some figures on this population, obtained through monthly censuses carried out in an intensively studied plot.

The maximum total number of birds per hectare occurs during the rainy season and coincides with the autumn passage of the Palaearctic migrants, in September–October: this maximum is 5.5–10 birds/hectare; and the minimum, which occurs in May–June, at the end of the dry season (when all the Palaearctic species have left) is 1–1.5 birds/hectare. The ratio of 10:1 between the maximum and minimum is large, yet the density of the total population is low, even at the maximum of 10 birds in the rainy

season. These figures, however, are somewhat different for several large sized species which were not regularly censused: the larger bustards, the Ground Hornbill *Bucorvus abyssinicus*, the Helmeted Guinea-fowl, the Ostrich *Struthio camelus* are not included in our figures, because of their irregular distribution.

On a more general basis, it is easy to realize that the gap between the maximum and the minimum has to be filled by migratory birds, either Palaearctic or Afrotropical.

Two sorts of Palaearctic migrants are observed on the bush steppe: those that are only on passage and winter farther south, and those that actually winter in the steppe.

*The passage migrants* have not received much attention; for example the Cuckoo *Cuculus canorus*, Golden Oriole *O. oriolus*, several warblers and Ortolan Bunting *Emberiza hortulana*, after crossing the Sahara in the autumn, remain some time in the Sahel, obviously in order to make some recovery. Now, the Sahel in autumn offers, depending on the rains, uncertain resources and this variable, unreliable situation is likely to influence the progress of the migrants, so that their sojourn is unpredictable from year to year.

The wintering visitors in the Sahel have been the subject of many studies—yet rarely long term ones—in order to determine which factors are responsible for their fluctuations and, for some of them, their decline. But it is difficult to disentangle and estimate the different factors at work in the survival of migrants wintering in the Sahelian bush steppe such as, for instance, Common Quail *C. coturnix*, Wryneck *Jynx torquilla*, Hoopoe *Upupa epops*, Woodchat Shrike *Lanius senator*, Tawny pipit *Anthus campestris*, Redstart *Ph. phoenicurus*, Wheatear *Oe. oenanthe* and Whitethroat *Sylvia communis*. Chiffchaffs *Phylloscopus collybita* winter in the riverine vegetation of the valley, not in the steppe itself.

Several ornithologists (R. E. Moreau in particular and more recently K. Curry-Lindhal) have attempted to analyze the conditions met by the migrants in this steppe and have wondered why and how migrants could survive at all in this sort of habitat. Although it is not relevant here to raise again these questions, I can make a few comments: the density of the wintering Palaearctic species is very low, which makes any discussion, e.g. on competition and niche saturation, very risky. Also, besides some arid land species (e.g. Wheatear, Bonelli's Warbler *Phylloscopus bonelli*), the others (e.g. Redstart, Wryneck, Whitethroat, Blackcap *Sylvia atricapilla*) winter also, and in larger numbers, in the much richer habitat of the valleys and we may wonder whether the Sahelian steppe is not a second choice habitat to which any surplus of migrants is forced to retreat, but this is pure speculation.

### The River Valley and the Wetlands

From this survey of the bush steppe and its sparse population, we can, within walking distance, go over to the valley. There, thousands of hectares of lowlands and pans are watered, not only by the small rains, but by an enormous volume of water flowing from Guinea. The resulting cornucopia provides several categories of food.



### Fish

Most species of fish spawn when the lowlands are flooded, where they find the new grass, seeds and insects. Then, the fry meet several fates: many small fish are caught in ponds, isolated by the falling water levels, but the rest are able to reach the river or more or less permanent marshes. From the birds' point of view, the most significant fish are those that can be captured regularly. Some quantitative data are available and they are impressive; they can compare with the richest waters in other parts of the world.

Undoubtedly, the most conspicuous and important fish consumers are White Pelicans *Pelecanus onocrotalus*, whose numbers in the Senegal delta are somewhere about 5000 and which breed there. During their several months stay, with an average daily intake of 1 kg of fish per bird, we can accept a consumption of at least 5 tons a day for this species.

In the heron family, Egrets, Squacco *Ardeola ralloides* and Night Herons *N. nycticorax* reproduce in mixed colonies with Long-tailed Shag *Phalacrocorax africanus*, African Darter *Anhinga rufa* and Wood I. *ibis* and Sacred Ibises *Threskiornis aethiopicus*, from the outset of the flood, catching fish in the shallow waters; several thousands of nests have been censused. Other less conspicuous species take their share of fish: kingfishers, gulls and terns. Even rather clumsy species fish whenever it is easy, the White Stork *C. ciconia* for instance.

These fish consumers have several characteristics in common. Because their food supply undergoes big fluctuations, they are migratory, either towards the Palaearctic or within the continent. Pelicans, for example, wander in search of plentiful food from northern to southern Senegal, northward along the Mauritanian coast and probably eastward also to Mali and perhaps farther east to Chad.

Several of these species breed in colonies, all more or less vulnerable to predation. The pelicans, owing to their conspicuousness and the length of their breeding cycle, need very secure islets together with an abundant supply of fish; they are thus often compelled to travel considerable distances, up to 100 km, to obtain their food. The colonies of herons and cormorants are often raided by poachers and the trees on which they nest (*Acacia nilotica*) are felled for charcoal.

The consumption of such vast quantities of fish, even though most are of small size, raises the question of competition with Man, himself an important and ruthless fish consumer. The sharp decline of several fish-eating bird species in regions where fisheries have been developed (Cape of Good Hope) is a good example. In the Sahel, either in the Senegal or Niger valleys, although the locals fish actively, such competition does not seem an immediate threat: small fish are usually ignored. But agricultural developments, which generally put an end to natural flooding, heavily disturb the breeding cycle of the fish and of their predators. Man's ultimate remedy, disastrous for birds, is fish-farming.

### Invertebrates

The sudden swarming of invertebrates during the rainy season is all too familiar to those who have lived in the tropics, if only for the profusion of unpleasant little creatures. The consumption of insects by birds is much

more widespread than that of fish—undoubtedly because it involves less fundamental adaptations, but also because insects are found everywhere, in water, soil, vegetation and in the air. Accordingly, the predators of insects, both Palaearctic and Tropical, are very varied. Many species have a mixed diet and take also fish, seeds and amphibians, so that variety is further increased.

The largest population of insectivorous birds are found near the river. Among those from the Palaearctic, several species or groups are of particular interest for example, sandpipers and stints, Garganey *Anas querquedula* and Pintail *A. acuta*, which number hundreds of thousands, all of which, though waterbirds, have a mixed diet. Several insectivorous passerines are also important insect consumers. The most noticeable are Sand Martins *R. riparia*, White *M. alba* and Yellow Wagtails *M. flava* and the warblers which inhabit the riverine vegetation (e.g. Whitethroat, Blackcap, Chiffchaff). All the Palaearctic migrants, with a few exceptions, such as the Turtle Dove *Streptopelia turtur*, eat insects to some extent.

### Seeds

The production of wild seeds (Graminaceae, water-lilies) is sufficiently large to have prompted Man to harvest them, as I myself witnessed some years ago. The yield of certain grasses (*Panicum*, *Echinochloa*) is 200 or 300 kilos per hectare, whereas Sorghum, without fertilizer or irrigation, does little better.

Seeds are eaten by both Palaearctic and African species. Amongst the Palaearctic species are Garganey, Pintail (also partly insectivorous), and Ruffs *Philomachus pugnax*, whose population, in the region of millions is partial to rice-fields, where they pick up the spilled grain, Black-tailed Godwit *L. limosa* and, during the spring passage, millions of Turtle Doves.

The Afrotropical ducks are far less numerous than the Palaearctic ones and, of course, there are practically no tropical waders.

But one of the major seed-consumers is an African passerine, the Red-billed Quelea *Q. quelea*, which is the most numerous bird in the continent, breeding in colonies with hundreds of thousands of nests. I counted on a single *Acacia raddiana* c. 1200 nests. The nestlings are fed both seeds and insects and the adults roam the lowlands in search of grass seeds. Unfortunately for these little birds, and for Man, it is a small step from wild seeds to cereals, and agricultural projects are precisely developed (for obvious reasons) in the Sahel valleys, where granivorous birds are most abundant.

### Fruit

Fruit is the only food category which is not really plentiful and, interestingly, none is produced during the rains.

In conclusion, I hope the above points underline, as I intended, the contrasts observed in the Sahel between the rich wetlands and the arid bush steppe. I have also emphasized the fundamental variability of the Sahel as a whole, seasonally and annually, and its main consequence,

namely the enormous and temporary surplus which can be utilized only by immigrant populations, to such a point that, equally paradoxically, several Palaearctic bird species greatly outnumber the local ones, especially in the Sahelian wetlands.

The sharp contrast between wetlands and arid steppe, between the dry season and the short rainy season, the unpredictable variability of the climate (in certain years the rains fail almost completely) have all contributed to the evolution of the migratory birds, study of which has fascinated so many ornithologists and whose evolutionary adaptations are still under constant and active pressure.

From the ornithologist's point of view, the study of migrations, and particularly the migration over north and western Africa, because it raises so many challenging questions, is certainly one of the most stimulating, but also one of the most difficult. Without seeming over-pessimistic, I can say that when one thinks one has discovered at last a solution to a problem in this field, the next season often brings one contradiction, and one has to go back to the birds and study them again; but this is the rule of one's favourite game, ornithology.

## Swinhoe's Storm Petrel *Oceanodroma monorhis*; a species new for Thailand

by Duncan Parish & Surapol Ardseungnurn

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On 18 October 1985 the corpse of a small, dark, petrel was found in Ban Da To Village, 10 km east of Pattani Town, on the east coast of the Thai Peninsula in South Thailand (6°55'N, 101°20'E). The bird was discovered by the authors during a joint survey of Pattani Bay by INTERWADER (The East Asia/Pacific shorebird Study Programme) and Prince of Songkla University (PSU). The bird, which appeared very fresh, was found on a pile of rubbish next to a house, 20 m from the shore of the Bay. According to the villagers, the bird had been accidentally caught the previous night in a net set for fish in the bay.

### Description

A small, all-dark petrel with a forked tail. Overall plumage dark brown with a pale brown bar across the greater wing coverts. The basal parts of the outer 6 or 7 (depending on wing) primaries had white shafts, but this would probably not be visible in the field. Soft parts were all black. The following measurements were made: wing 156 mm (unflattened), 161 mm (maximum-chord); outer tail feathers 70 mm; central tail feathers 57 mm; tarsus 24 mm; culmen 15 mm; bill tip to tail tip 195 mm; wingspan 480 mm.

There are 7 species of all-dark petrels with forked tails: Swinhoe's Storm Petrel *Oceanodroma monorhis*, Matsudaira's Storm Petrel *Oceanodroma matsudairae*, Markham's Storm Petrel *Oceanodroma markhami*, Tristram's Storm Petrel *Oceanodroma tristrami*, the dark-rumped form of Leach's Storm Petrel *Oceanodroma leucorhoa chapmani*,